National Synchrotron Light Source II

Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY

ADTimePix3 areaDetector driver

and MiniPix TPX3

Kazimierz Gofron

EPICS Collaboration Meeting

Ljubljana, Slovenia
September 21, 2022

ASC TimePix3

- An EPICS areaDetector driver for TimePix3 quad 512 x 512 detector from ASC.

- ASC https://www.amscins.com/

- NSLS2/CHX – Coherent Hard X-ray Scattering beamline

- TDC – Timing from accelerator (260 ps); DIO: 2 x 3 (timing signals)
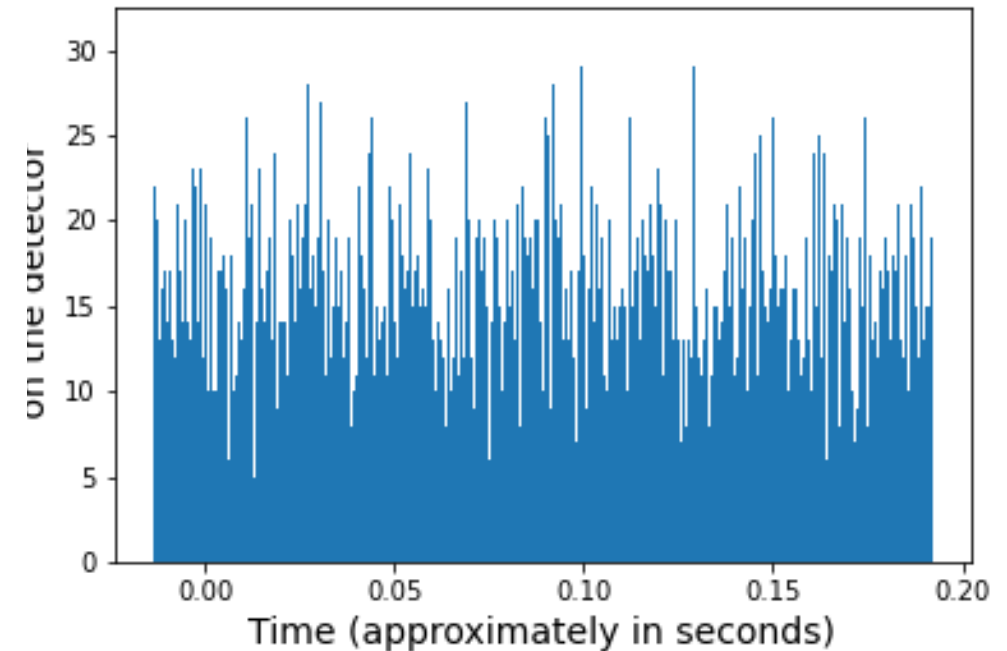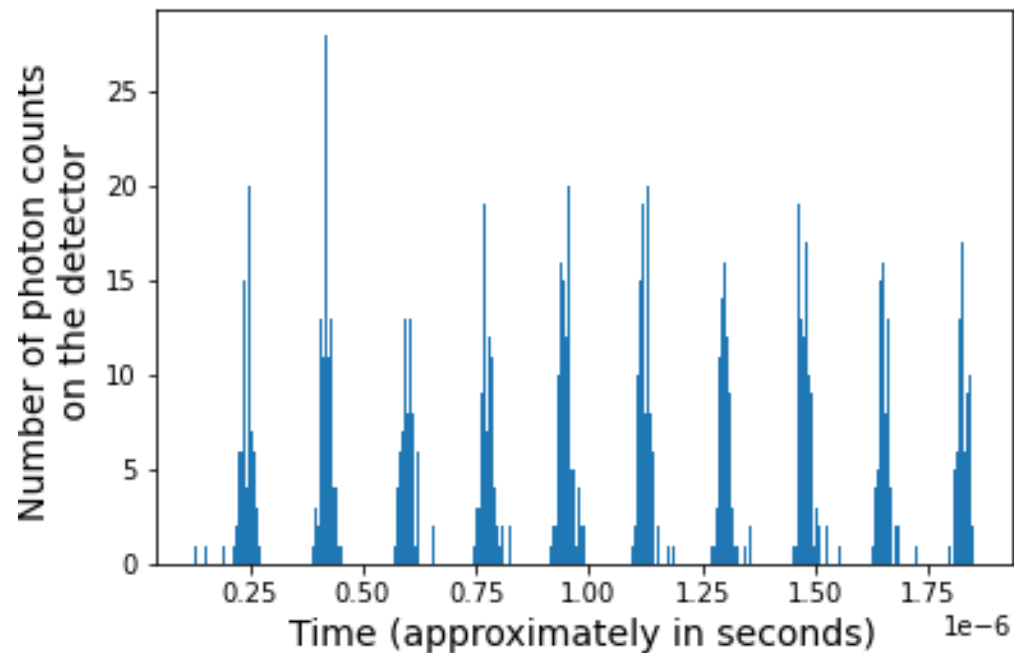

National Synchrotron Light Source II
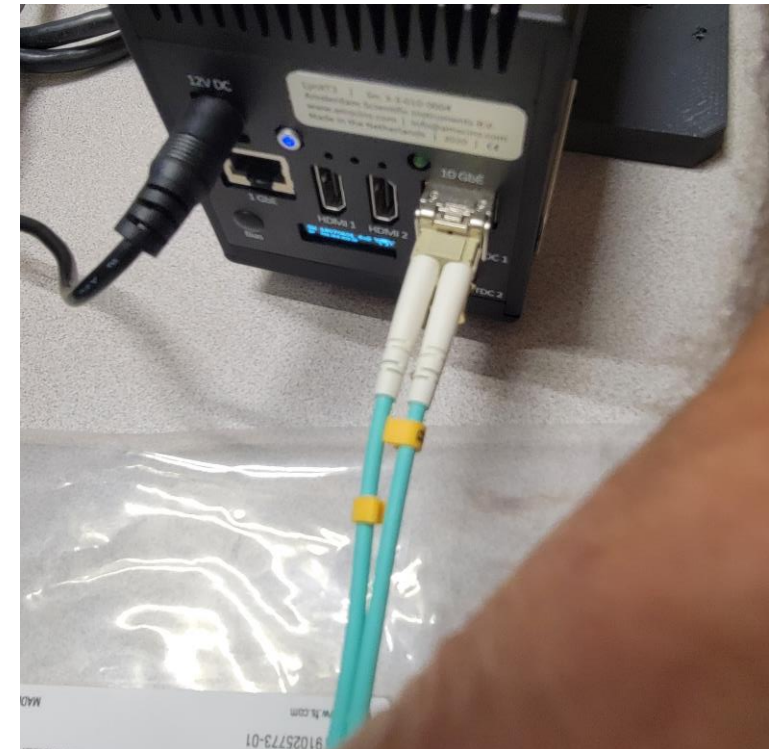
ASC TimePix3 diffraction pattern
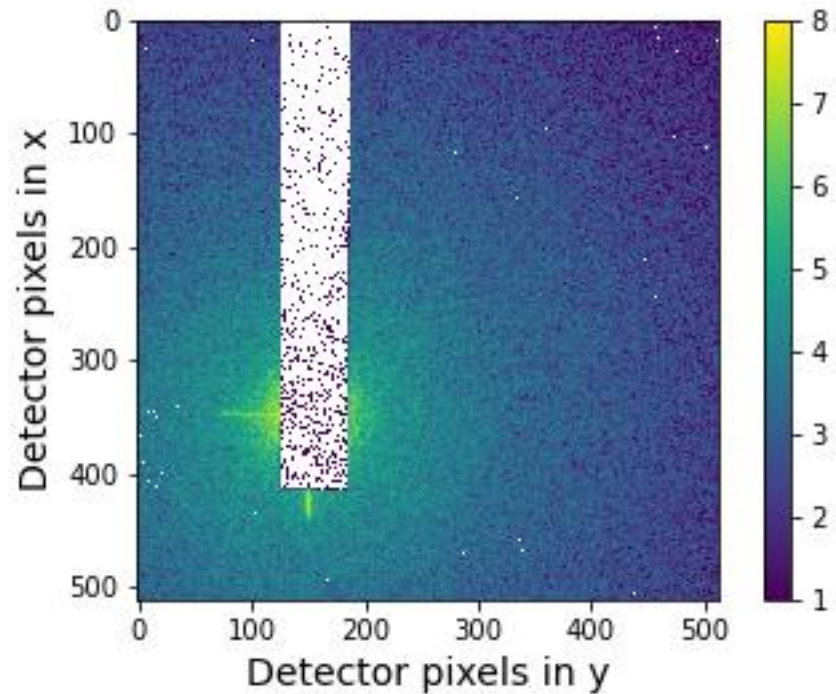
X-ray diffraction pattern from a static ceramic sample on the Timepix single photon counting detector. Data was taken with 15 bunch mode with a ring current of 63 mA. Total exposure time = 3 seconds and the image is in log scale.

Courtesy: Chen, Xiaoqian

ASC TimePix3 timing pattern

Histograms of time stamps showing statistics of when photons arrive at detector pixels for data in Fig.1. (a) 15 bunch mode with a ring current of 63 mA. (b) Continuous filling mode with a ring current of 68 mA. Courtesy: Chen, Xiaoqian

An areaDetector driver for TimePix3 detector from ASC

- Notes
    - Depends on the CPR verson 1.9.1.
    - Depends on the json version v3.11.2.
    - Developed with ADCore R3-11 and ADSupport R1-10 or newer.
    - This has only been tested on ubuntu 18.04 and 20.04 Linux 64-bit machines.
    - This has only been developed for 2 x 2 chips layout, since that is what I have access to now
    - This has only been tested with serval version 3.0.0.
    - Driver is specific to Serval version, since features differ.
- Dependencies (**ADTimePix3**/**tpx3Support**/)
    - Compile cpr (https://github.com/libcpr/cpr)
    - Clone json (https://github.com/nlohmann/json)

An areaDetector driver for ASC TimePix3 detector

- Json C++ library use

```
std::string config;
config = this->serverURL + std::string("/detector/config");

// Detector configuration file
r = cpr::Get(cpr::Url{config},
            cpr::Authentication{"user", "pass", cpr::AuthMode::BASIC},
            cpr::Parameters{{"anon", "true"}, {"key", "value"}});

json config_j = json::parse(r.text.c_str());
config_j["BiasVoltage"] = 103;
config_j["BiasEnabled"] = true;

//config_j["Destination"]["Raw"][0]["Base"] = "file:///home/kgofron/Downloads";
//printf("Text JSON server: %s\n", config_j.dump(3,' ', true).c_str());

r = cpr::Put(cpr::Url{config},
            cpr::Body{config_j.dump().c_str()},
            cpr::Header{{"Content-Type", "text/plain"}});

printf("Status code: %li\n", r.status_code);
printf("Text: %s\n", r.text.c_str());
```

National Synchrotron Light Source II

ASC ADTimPix3 opi

Detector requires hardware confiuraiton:
1. Binary Pixel Configuraton file loading from CSS
2. DACS configuration files loading from CSS

National Synchrotron Light Source II

ASC TimePix3 opi

- An EPICS ADTimePIx3 detector status, and FileWriter.

FileWriter configuration for channels
- Raw
- Image
- Preview
  - Image
  - Histogram

ASC TimePix3 opi

- Detector configuration, and controls.

ASC TimePix3 disk data structure

- Currently data written to NVME internal disk for performance
- NVME
  - Raw
  - Img
  - Prv
    - Img
    - Hst {Serval experimental version support}
- Data write rates (>> 1GB/s)
- EPICS channel used for viewing
- .tpx3 data format

National Synchrotron Light Source II

Advacam MiniPix TPX3 (IXS/10ID beamline)

Analyzer Optics

CDW
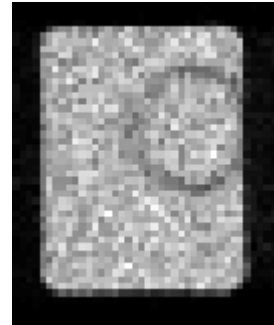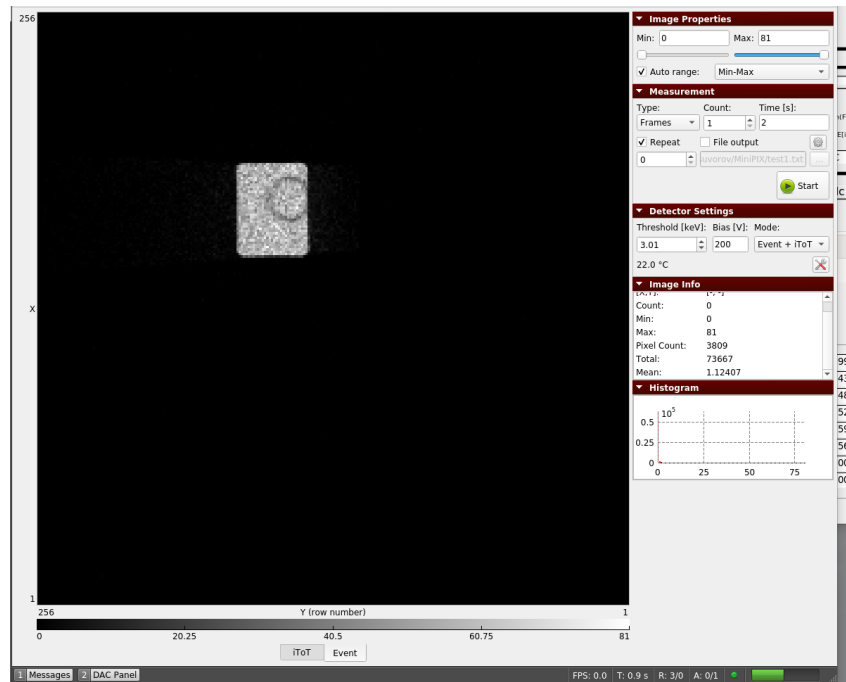
Montel Mirror

Sample

MiniPix image of inelastic scattered 9.1 keV X-ray beam behind slits mounted in front of Montel Mirror.

Advacam: https://advacam.com/

Summary

- An EPICS ADTimePix3 areaDetector driver for 2x2 ASC TimePix3 was developed.
    - Uses Curl for human's library
    - Uses json library
    - Driver features are being added, as beamlines request their use.
    - Coordinate with ASC (Serval), and beamline scientists

- Advacam MiniPix TPX3 as replacement for ADP detector.